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Contents

No Mean Adversary

OUR READERS will already be aware, of the work of Tecwyn Jones, Forest Entomologist, East African Agriculture and Forestry Organisation, whose account of the aberrant longhorn beetles boring into living trees, was one of the highlights of the 1960 B.W.P.A. Annual Convention, (see *Pest Technology* **2** (11) pp 231-234 and *Rec. of British Wood Preserving Association Annual Convention*, 1960).

The difficulty of studying these insects in their natural cryptic habitat was adequately explained by Mr. Jones at the B.W.P.A. Convention. To determine the degree of infestation in a plantation the felling of sample trees is an obvious but uneconomical method. Hand boring of sample trees has been tried but it took twenty minutes to produce one eighth inch thick core from the tree, moreover six to eight borings had to be made into each tree in order to carry out a thorough check.

The use of an ultra sonic pulse was also investigated, signals from a minature crystal transmitter at one side of the tree, being picked up by a minature crystal receiver on the other. Unfortunately the maximum penetration into the trunk was only eight inches, the generator to supply the necessary electric power was heavy and the technique, as a whole, expensive.

While Mr. Jones was in England last year he called at the Atomic Energy Research Station, Wantage but was unsuccessful in his search for more efficient methods of investigation. The use of non directional gamma rays in a radiography technique was ruled out because of rediation hazards and although these could be nullified by the use of a lead shield the weight of the apparatus would then become prohibitive. The atom scientists suggested the alternative use of a scintillation counter but quickly gave up the idea on seeing a sample of the timber to be tested.

For determining the number of infested trees in a plantation Mr. Jones has reverted to the original technique of drilling sample trees, only this time an electrical power drill will be used, which will enable the work to be done ten times as quickly.

With typical Welsh fervour Mr. Jones has made recourse to several ingenious ideas for laboratory studies of the timber borer (*Oemida gahani*) including the use of a microphone through which the movements of the one inch long larvae sound like a stampede of wild elephants. The latest technique is to rear the larvae in four inch square blocks which every two weeks he takes the King George VI Hospital, Nairobi to be X-rayed. By the use of X-rays the larvae can be observed undisturbed and should the technique prove successful

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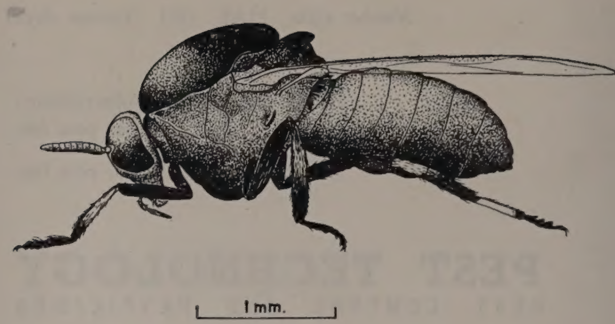
BLACK FLIES—PESTS OF MAN AND ANIMALS



The black-fly Simulium damnosum

Part I: Biology and Economic Importance

By R. W. CROSSKEY,* M.Sc.

THE BLACK-FLIES form a distinctive family of flies—Simuliidae—with a world-wide distribution; they are all very small insects but not always black, some like *Simulium ochraceum* being predominantly orange-yellow. There are about 1,000 species but only a few of these are of importance to man; nevertheless these few species present very important medical and veterinary problems, since some are vectors of onchocerciasis and others are responsible for heavy mortality among livestock. In addition there are several species of black-flies which are very troublesome pests and of considerable economic importance as a direct result of their mass biting of man. The pest species almost all belong in the genus *Simulium* and occur principally in North and Central America and in Africa, but there are pest species in many other parts of the world. Even in remote islands such as the New Hebrides and the Marquesas Islands there are black-flies which cause much human suffering from their bites. The accompanying table summarises the principal pest species and their relation to man; in addition to the species listed there are others which are known to bite man or animals occasionally but are not major pests.

Life history and habits of black-flies

The early stages of all black-flies are aquatic and larvae and pupae live attached to vegitation or rocks in flowing water, sometimes clustered in large masses. Many species are fairly catholic in their choice of breeding site but others are characteristically species either of large swift rivers (e.g. *S.arcticum, S.damnosum*) or of the smallest streams (e.g. *S.ochraceum, S.venustum*); the nature of the breeding watercourse is of profound importance in black-fly control. In contrast to the mosquitoes the larvae and pupae do not occur in stagnant water, although the African species *S.ruficorne* is remarkable in this respect as it sometimes occurs in more or less stagnant swamps and is even known from a desert oasis in Sinai. In a curious group of African species the larvae and pupae are attached to crabs or to mayfly nymphs; the East African pest species, *S.neavei*, lives in association with crabs. The origin and purpose of the crab-*Simulium* relationship is not understood, but its existence influences the control of this species.

The eggs are usually laid in masses of two or three hundred and are attached to vegetation or stones near the water surface, but in Canada the pest species *S. arcticum* drops its eggs singly over the water and they sink to the sandy river-bed, there to lie dormant under the ice during the long winter. In this case the black-flies over-winter in the egg stage and hatch with the spring thaw but in some species (e.g. *P. hirtipes*) it is the larvae which over-winter. In the tropics the eggs hatch very rapidly and provided the rivers and streams keep flowing perennially there is continuous breeding with many generations of flies per year; but where there is a severe dry season and the watercourses dry up completely for several months of the year, as in parts of Africa or the semi-desert areas of southern Queensland the black-flies have a quiescent phase to survive the drought period. There is still no very satisfactory

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evidence as to how they achieve this remarkable survival, although in the case of *Austrosimulium pestilens* there is believed to be a drought-resistant egg.[23] In *S. damnosum* some evidence is accumulating that it may be the adult female which survives.

Pupal life is usually short, only a few days, but the length of larval life varies much in different species and under different conditions. It is probably much infleunced by temperature and in cold northern latitudes the larvae may live several months (during over-wintering) or a few weeks during spring and summer. In the tropics larval life is probably always short (few dependable estimates exist) and in *S. damnosum* is believed to be about 6-13 days, so that tropical species probably have many more generations in a year than temperate species.

Male and female black-flies emerge from the pupae in about equal numbers but the males are very rarely seen after emergence and almost nothing is known of male behaviour since this sex (in contrast to tsetse-flies) does not suck blood; only the females are blood-sucking and therefore responsible for the transmission of pathogenic organisms and for toxaemia of domestic animals. Possibly the females of most black-flies are ornithophilic (many species possess a tooth at the base of each claw which probably aids them among the feathers of birds), but many species feed on domestic and wild animals; comparatively few species feed on man and probably no species is exclusively anthropophilic. It is not definitely known how long black-flies may live in nature, but *S. damnosum* females probably live about three weeks and must live at least two weeks to allow the development of *Onchocerca* worms to the infective stage and maintain onchocerciasis transmission. The flies take several blood meals during their life and probably make several ovipositions since maturation of a batch of eggs appears to succeed each feed. Feeding always takes place during daylight hours (in contrast to the mosquitoes.)

Direct economic effects of black-flies

Apart from their veterinary and medical importance black-flies have many direct economic effects from their mass biting of man. Two examples may be given, both of which involve the two scourge species *P. hirtipes* and *S. venustum*.

In the delightful area of the Adirondack Mountains of New York State the black-fly menace plays a major part in influencing the tourist trade. The prosperity of this neighbourhood depends on its income from the hotel trade during the summer months; until 1948, when black-fly control was instituted in the area, the effective hotel season did not begin until mid July as the black-fly pests made the area almost intolerable during the spring and early summer. But the annual application of insecticides during the last few years has brought the black-flies under such effective control that the tourist season now begins in May and the economic gain to the community has been startling—in some cases small backward townships have become thriving holiday centres.

In Quebec Province of Canada black-flies have an extremely deleterious effect on the cutting of timber in the woods along the north shore of the St. Lawrence estuary. Pulp-wood for paper manufacture must be cut during the summer months when the black-fly incidence is highest, and the appalling biting swarms of black-flies cause a high labour turnover in the pulp-wood cutting camps. As a result the Pulp and Paper. Research Institute of Canada has for some years sponsored an investigation into the black-fly problem, and effective annual control is now carried out, with the result that timber is cut more efficiently and economically and with much less discomfort to personnel.

Veterinary importance

Black-flies are of great veterinary importance because of the mortality which ensues from their mass attacks on livestock. It is characteristic of the veterinary pest species that they occur in sporadic outbreaks in certain years, other years being almost free of them. During the summer of a "black-fly year" they may occur in enormous numbers, killing cattle and other domestic animals as a result of toxaemia caused by their mass biting; although toxaemia is the primary cause of death, actual loss of blood and blocking of the nasal and bronchial passages through inhalation of flies are contributory factors.

The worst recorded outbreak of livestock-biting black-flies occurred in 1923, when the lower Danube valley (mainly in Roumania but also in Jugoslavia and Bulgaria) a total of 16,474 domestic animals died from an outbreak of *S. columbaczense*[10]; about half were cattle, but pigs, sheep, goats and horses were also killed—the human population was badly bitten but no fatalities occured. In the same region another bad outbreak took place in 1934, when parts of Yugoslavia near the Danube suffered worst with the loss of over 11,000 head of livestock[34], made up of 25% cattle, 58% sheep and goats, 10% pigs, and 7% buffaloes, horses and donkeys. A side-effect, recorded in Roumania, was that the skins of badly bitten animals tended to crack during tanning.

Similar black-fly outbreaks occur from time to time in North America, principally along the lower Mississippi where *Cnephia pecuarum* is responsible for the death of mules and in southern Saskatchewan where outbreaks of the prarie black-fly *S. arcticum* cause the death of cattle and other livestock. In the 1860's to 1880's there were several serious outbreaks of *C. pecuarum* in Arkansas and Mississippi but it was not an important pest again

until 1927 and 1928; then in quick succession two more serious outbreaks occurred in 1931 and 1934 in which over 1,500 mules were killed[6]. In Saskatchewan there was a major outbreak of *S. arcticum* in 1918 but the next was not until the summers of 1944, 1945 and 1946, when some 800 domestic animals (mostly cattle) died[30]. In Soviet Azerbaijan recent outbreaks of *S. tarnogradskii* have caused the death of many domestic buffaloes[1].

Deaths of domestic animals mostly occur in the periodic black-fly waves, but in less severe outbreaks when no deaths occur or in normal times black-fly biting may still have important effects; their biting of cattle for example is believed to play some part in lowering milk production, loss of weight and possibly abortion. Domestic animals when badly attacked fatigue easily and lose appetite; more severe symptoms may occur and in the major outbreaks death may be very rapid, occuring within a few hours. The southern Queensland pest species, *Austrosimulium pestilens*, during its worst outbreaks, drives cattle from their watering-places and forces them into a close-packed milling herd which obtains some relief from biting by the dust cloud it stirs up; Queensland stockman claim that there is no need to muster cattle during the worst outbreaks since they will all be found together, and that wild kangaroos (believed to be the original hosts of *A. pestilens*) sometimes die from the simuliid bites[23].

A further important veterinary effect of black-flies is the ability of some species to transmit *Leucocytozoon*, a sporozoan parasite which can be fatal to turkeys and ducks in the United States and Canada, especially in Virginia where *L. smithi* is transmitted by *Simulium jenningsi* (= *S. nigroparvum*) and causes considerable mortality among turkeys[21]. It is also possible that simuliids transmit onchocerciasis of domestic animals, and there is evidence that *S. ornatum* is a vector of *Onchocerca gutturosa* among cattle in England. In South America the horses of the Venezuelan Army are frequently infected with *Onchocerca* and black-flies are the possible vectors.

Medical importance: Human onchocerciasis

Human onchocerciasis is widespread in tropical Africa and occurs also in limited areas of the New world. It is perhaps not truly endemic in the Americas where it was probably introduced through the agency of the slave trade, with the transportation to the lands around the Caribbean of infected negro slaves from the West coast of Africa. The causal organism of the disease is a filarial nematode worm, *Onchocerca volvulus*, which has as its intermediate host several species of *Simulium*. In contrast to some Diptera-transmitted diseases, such as malaria and sleeping sickness, onchocerciasis is never a fatal disease but it can cause complete blindness in severe cases and therein lies its importance to man; aside from its ocular complications it gives rise to great suffering through the intense itching of the skin.

The disease is characterised by the presence of the

TABLE I.

Principal black-fly pests and their effects.

Pest Species	*Principal area of the pest*	*Effect of the pest*
Simulium ornatum	England, northern Europe	Transmission of cattle onchocerciasis, attacks on livestock.
Simulium columbaczense	Central and southern Europe.	Death of livestock, mass biting of man.
Simulium cholodkowskii	U.S.S.R. (eastern Siberia).	Mass biting of man.
Simulium decimatum	U.S.S.R. (eastern Siberia).	Mass biting of man.
Simulium mathiesseni	U.S.S.R. (Lower Volga).	Mass biting of man.
Simulium tarnogradskii	U.S.S.R. (Azerbaijan)	Death of livestock.
Prosimulium hirtipes	Canada (mainly Quebec)	Disruption of lumbering through mass biting of man.
	U.S.A. (mainly New York State).	Harmful effect on tourist resorts through mass biting of man.
Simulium venustum	Canada and U.S.A.	(as for *P. hirtipes*)
Simulium jenningsi	U.S.A. (mainly Virginia)	Death of poultry.
Simulium arcticum	Canada mainly Saskatchewan)	Death of livestock.
Cnephia pecuarum	U.S.A. (Mississippi and Arkansas)	Death of livestock.
Simulium indicum	Himalayayas	Mass biting of man.
Simulium damnosum	Tropical Africa	Transmission of human onchocerciasis
Simulium neavei	East Africa.	Transmission of human onchocerciasis
Simulium bovis	Nigeria	Possible transmission of human onchocerciasis.
Simulium griseicolle	Sudan	Death of turkeys, mass biting of man.
Simulium ochraceum	Mexico and Guatemala	Transmission of human onchocerciasis and mass biting of man.
Simulium metallicum	Mexico and Guatemala	Transmission of human onchocerciasis.
	Venezuela	Probable transmission of human onchocerciasis
Simulium callidum	Mexico and Guatemala	Probable transmission of human onchocerciasis.
Simulium haematopotum	Venezuela	Mass biting of man.
Simulium antillarum	Guadeloupe	Mass biting of man.
Austrosimulium pestilens	Australia (S. Queensland)	Death of young livestock, biting of man.
Simulium buissoni	Marquesas Islands	Mass biting of man.

young embryo worms (microfilariae) of *O. volvulus* in the skin (whose presence is the presumed cause of the skin irritation) and the examination of skin-snips is the usual method of diagnosis. In intensely infected cases the density of microfilarial worms is often very heavy and there may be two hundred or more microfilariae in a few square millimetres of skin. The black-fly vectors have a short rasping type of proboscid (unlike the long piercing proboscis of mosquitoes or tsetse-flies) which creates a small feeding-site wound from from which blood, together with the microfilariae, is ingested; once within the black-fly host the worms undergo a period of rapid metamorphosis during which they increase greatly in size and migrate from the alimentary canal via the thoracic flight muscles and the neck to the head and mouth-parts, whence they may be transmitted to man when the fly takes another blood meal. The life-cycle of *O. volvulus* within the black-fly intermediate host usually occupies about 10-15 days.

The subsequent history of *Onchocerca* in the human host, after it has been passed on at the infective black-fly bite, is still very imperfectly known, but after some time (how long is uncertain) worms become sexually mature and the females reproduce viviparously, extruding abundant microfilariae which distributes themselves in the skin. Frequently the adult worms become encapsulated in a tough fibrous nodule and the presence of superficial nodules—as a rule where the tissues are thin over the bones as on scalp, ribs or iliac crests—is a symptom of onchocerciasis. Some evidence has recently been found at autopsies that deep-seated nodules also occur. The removal of the superficial nodules is practised in Mexico as a means of combatting onchocerciasis, nodule excision reducing the output of microfilariae available for transmission.

In many areas where heavy infections with onchocerciasis occur there may be little or no blindness from this cause (for example in the forested areas of the Cameroons), while in other areas only a few hundred miles away blindness may be a major problem with up to ten per cent of persons blind in the worst affected villages (as in parts of the savannah areas of Northern Nigeria and Northern Ghana). There is much dispute at the present time as to the mechanism whereby onchocerciasis induces blindness, and some authorities have recently doubted that it does in fact do so—suggesting that certain eye lesions found in onchocerciasis cases are not in reality the outcome of infection with *O. volvulus* but due to other factors. But there is much solid evidence that onchocerciasis is a major cause of blindness in many areas, though not every-where that it occurs, and in general medical opinion still holds that onchocerciasis is one of the important blinding diseases of the world.

American onchocerciasis. The disease is well known

Larviciding against Simulium damnosum *on a river in Northern Nigeria.*

in Guatemala and Mexico, and about twelve years ago was discovered in Venezuela[29]; it may also occur in Brazil, Ecuador and Surinam but this is not proven. Only in Guatemala and Mexico has it been intensively studied, and in the latter country a control campaign has been waged for some years[33]. In Guatemala there is a principal onchocerciasis zone of about 500 square miles along the Pacific-facing slopes of the mountainous hinterland and a smaller zone of about 85 square miles in the north-west; in Mexico there is a zone in Oaxaca State and two zones in the southernmost state, Chiapas, but it is possible that one of the latter zones is continuous with the small zone in Guatemala. The onchocerciasis zones are closely circumscribed and apparently well defined (unlike most of the African endemic areas) and occur only between 1,500 and 4,800 feet above sea-level in irregularly folded mountainous areas which are densly forested and provide innumerable tiny streams for the breeding of the principal vector, *Simulium ochraceum*.

Coffee is widely grown in the areas where onchocerciasis occurs, and the workers on the coffee fincas are the chief sufferers from the disease. About 25,000 people are believed to be infected in Guatemala and from 35,000 - 50,000 in Mexico; these figures are very low indeed in comparison with Africa, where such numbers might be infected in one small native Emirate of Northern Nigeria alone.

In American onchocerciasis the highest densities of microfilariae occur in the upper parts of the body, and the nodules are mainly on the head and shoulders.

The chief vector, *S. ochraceum*, bites almost entirely on the upper parts from the chest upwards, even attacking the face and ears, and getting in the hair; thus it is very likely to ingest microfilariae while feeding. The highest fly densities occur in the dry-season and probably most transmission occurs in December and January, the middle of the dry-season. During the peak time the black-flies can be an intense pest from the numbers in which they attack.

African onchocerciasis. In tropical Africa onchocerciasis is extremely widespread but its distribution is sporadic and the total endemic area cannot be reliably estimated, partly because many areas are still unsurveyed for the disease but also because the foci are ill-defined. The disease occurs here and there from Sierra Leone and Liberia in the west to Sudan and Ethiopia in the east and south-eastwards to the Congo, Uganda, Kenya and certain areas of Tanganyika. In West Africa it occurs to about 13°N latitude and reaches about the same latitude south of the equator; hence onchocerciasis is absent from the whole of southern Africa including the Rhodesias, Mozambique and South Africa. African onchocerciasis is not associated with any particular type of terrain, nor with particular altitudes, and occurs down to sea-level in the Southern Cameroons (where the vector *Simulium damnosum* even bites on the beach).

Although large and important onchocerciasis foci exist in the Congo basin and in eastern Africa, probably the largest and most intensive endemic areas of the disease are in the West African savannahs where one large diffuse focus may cover several thousand square miles (as in southern Adamawa Province of Nigeria). Such large foci sometimes occur in areas of impoverished farmland and low population density—though sound evidence that onchocerciasis *per se* is a cause of depopulation is wanting. It is not known how many Africans are infected with onchocerciasis but in Northern Nigeria alone it has been calculated that over 339,000 people are infected of whom some 20,000 are blind from the disease[9]. It has also been estimated that the vector (*S. damnosum*) occurs over about one-third of the area of this territory, or about 90,000 square miles[11].

S. damnosum is the only vector in West Africa (though *S. bovis* is suspected of local transmission[12]) and in much of central and eastern Africa, but in parts of eastern Congo, Uganda and Kenya *S. neavei* also transmits the disease. Both species bite mainly on the legs and lower parts of the body, where (in African onchocerciasis) the highest densities of microfilariae occur; the nodules are mostly found on the iliac crests, ribs and knees, though scalp nodules occur now and then. The highest fly densities usually occur in the rains, and there may be few or no flies about during the dry season, so that most transmission probably occurs in the wet season—although there may be transmission peaks when the rains are beginning and again when they are ending[13].

General aspects of control

Black-fly control on a large scale is a fairly recent aspect of applied entomology which has come to prominence since 1945 with the development of modern synthetic insecticides, particularly DDT. But the idea of black-fly control, especially by means of larvicides applied to the breeding grounds, is not new and as early as 1887 an attempt was made to kill black-fly larvae in streams with various compounds including kerosene emulsions[31]. In the earlier years of this century some workers [4,28,34,39] tried killing larvae by dosing streams with miscible or non-miscible oils, with tobacco extracts, Paris green, cresol-soap emulsions and so forth, and these methods achieved some eliminations of larvae over short distances, but the first careful comparative tests on different toxic substances were not made until 1934 in Siberia[32].

DDT as an insecticide against black-flies was first tried out in Guatemala in 1944-1945, and the success achieved led to the rapid adoption of this insecticide for control elsewhere. By 1946 DDT was in use in Canada and East Africa, and has since been used on an ever-increasing scale, so that the literature on DDT control of black-flies is already extensive. Some other synthetic insecticides have also been used but none has proved so effective as DDT and this insecticide is now in general use for black-fly control.

The use of insecticides is at present the only really practical and effective means of controlling the pests, although one successful control campaign by means of bush clearing has been carried out[8]. In Kenya *S. neavei* was eliminated from a small onchocerciasis pocket at Riana near Kisii by the discriminative clearing of vegetation, principally the removal of undergrowth and the smaller trees near rivers; five years after clearing *S. neavei* could not be found in the area and had apparently been exterminated by the alteration of the natural environment. It has been pointed out that large heavily wooded foci could not be dealt with in this way[26], and the almost complete eradication of *S. neavei* from Kenya has since been brought about by larviciding with DDT. The trapping of black-flies has not been investigated to any extent, but probably no trapping method could materially reduce the numbers of adult flies. There is some evidence that damming of rivers and streams brings about some mortality of black-fly larvae through the flooding of the breeding sites, and artificial management of watercourses might have local application for control. But there is no doubt that insecticides hold out the only real hope of large scale control or eradication in most areas.

(*To be continued*)

References will appear with the second part of this article in the June issue.

PROGRESS WITH INSECTICIDAL RESINS

By M. D. PRICE* B.Sc., A.R.C.Sc.

The idea of insecticidal resins is not new, but recognition of their value was somewhat delayed because of early failures. However, continued research, giving us a greater understanding of the principals involved, has led to the acceptance of insecticidal resins as a useful tool for industrial pest control.

INSECTICIDAL RESINS are the result of research to develop a semi-permanent residual insecticide capable of remaining on surfaces in a highly active state for many years.[1] It was found that when a crystalline insecticide such as DDT or dieldrin is incorporated into a mixture of a urea formaldehyde resin and an oil-modified alkyd resin, the insecticide goes into a solid solution within the resin solids. If sufficient insecticide is added, a saturated or super saturated solid solution can be obtained.

When such resins are applied to surfaces, an unusual phenomenon takes place. The resin rapidly dries to form a tough, transparent lacquer film. On drying, a small proportion of the insecticide migrates to the surface where it forms a fine "bloom" of microscopic crystals, either spontaneously or after mechanical stimulation (by crawling insects or by cleaning). If this bloom is removed by wiping or by washing, more insecticide is released from within the resin and the surface bloom of insecticide is re-formed. Insecticidal resins are therefore self-regenerating and repeated blooming can continue for two years or more depending upon the frequency of removal by cleaning. Thus resins are particularly useful in situations where deposits from spray applications of insecticide would be rapidly removed by normal sanitary operations such as the regular washing down of walls in hospitals and laboratory animal houses.

It is evident from this process of self-regeneration that the first advantage conferred by resins is to prolong the effective life of the insecticide. In laboratory tests to determine the life of resins containing dieldrin, it has been found that resin films 2, 3, 4 or more years old are at least as effective as freshly prepared films. The results of a biological assay on dieldrin resin films 6¼ years old are given in Table 1. It shows that 6¼ year old deposits are even more active insecticidally than a recently applied film. There is no reason why such films should not remain effective for many more years.

The longevity of resins has in fact been confirmed in practice against such pests as cockroaches,[2] Pharoah's Ant, bed bugs, etc. in ships, hospitals, kitchens and warehouses.

Safety factor

In principle, an insecticidal resin is a reservoir in which the bulk of the insecticide is safely locked within the solid resin film, and only a very small proportion of insecticide is released onto the surface at any given time. This in itself is a great safety factor which enables the more toxic insecticides to be used with safety, Experimental resins containing highly toxic chemicals such as endrin have been employed with safety and success in special circumstances.

Effect of film hardness

Properties of enhanced insecticidal action combined with a very long residual life in a resin are determined by two basic factors: the degree of hardness of the resin film and the concentration of insecticide.

When urea formaldehyde by itself is employed as a carrier for an insecticide, a very hard brittle film results with little or no insecticidal action, the insecticide being completely sealed within the resin. If however, the oil-modified alkyd resin is added as a plasticiser or softening agent, the resultant film is more pliable and the insecti-

* *Technical Director, Disinfestation Ltd.*

cide within the film can migrate to the surface. By increasing the proportion of alkyd resin, the rate of migration of the insecticide is increased until, with an excess of alkyd, spontaneous blooming will occur. Still further increases in alkyd produce heavier and heavier weights of bloom. This in turn means a heavier loss of insecticide from the surface when it is cleaned. Over-plasticised resins are therefore relatively short-lived and for best results, a balance has to be struck just below the point of spontaneous blooming but above the point at which a bloom can be stimulated by mechanical means, for example, by an insect walking over the surface or by cleaning.

Effect of insecticide concentration

The concentration of insecticide within the resin is also of vital importance in deciding the quantity of bloom, longevity and insecticidal efficacy. There appears to be a critical optimum concentration for each insecticide. If the concentration of insecticide is raised above this optimum the bloom becomes spontaneous and, with increasing bloom, individual crystals comprising the bloom become larger and form denser clusters. Finally, a stage can be reached with very heavy concentrations of insecticide when crystalization will occur throughout the mass of the resin film, all powers of regeneration are lost and the effective life of the insecticide is reduced.

Controlling the migration of the insecticide to the surface so that blooming does not occur spontaneously but is induced by slight mechanical stimulation, is important for another reason besides conserving and increasing the effective life of the insecticide.

With a correctly formulated resin the surface bloom is composed of small, vertical needle like crystals of insecticide and it has been shown by Gould[3] and others that given the same deposit of insecticide per unit area the smaller the crystal the greater the efficiency of the deposit because smaller crystals will adhere more readily to the insect which in consequence will pick up a larger dose of insecticide.

Initially insecticidal resins were used to control cockroaches, Pharoah's ant and to a lesser extent bedbugs particularly in ships but since resins are essentially vehicles for any residual type insecticide they have been employed against a wide range of crawling and flying pests. In Britain DDT, lindane, dieldrin, aldrin and eldrin have all been used in resin formulations against a multitude of pests ranging from Khapra beetle and other stored products pests to flying insects such as wasps, house-flies, blow-flies and fruit-flies. Resins have also successfully eradicated one or two unusual pests, for example an infestation of the Destructor ant, *Monomorium destructor*, which had caused damage to a ships electrical system due to its unexplicable appetite for lead covered

TABLE I.

Comparison of 6¼ year old dieldrin resin with recently applied dieldrin resin deposits on glass plates.

Treatment	*Replicate No.*	*No. of Insects*	*No. dead after 20 hrs.*	*No. dead after 48 hrs.*	*% Kill after 20 hours*
6¼ yr. old dieldrin resin (unstimulated)	1	30	25	29	84%
	2	30	25	30	
	3	30	26	30	
6¼ yr. old dieldrin resin (stimulated)*	1	30	18	26	60%
	2	30	17	27	
	3	30	21	29	
Recently applied dieldrin resin	1	30	15	22	47%
	2	30	13	19	
	3	30	14	22	
Control (untreated)	1	30	1	1	4%
	2	30	1	2	
	3	30	1	1	

* *These plates had previously been exposed to* Tribolium *adults two years earlier.*

Test Insect: Tribolium castaneum *adults 2-5 weeks old. Exposure Time on the deposits: 5 hours.*

TABLE II.

Comparison of 14 month old Diazinon resin with one month Diazinon resin on glass plates.

Treatment	*Total No. of Insects (4 Replicates)*	*Average % Kill After 48 Hours*
Diazinon resin 1 month old plates	120	60%
Diazinon resin 14 month old plates	120	57%

Test Insect—Tribolium castaneum *adults (2-5 weeks old)* Exposure Time on plates—½ *hour. (4 replicates of 30 insects for each treatment)*

* *Note.*

There was considerable variation between replicates in the individual results which tended to make the 14 month old resin appear slightly better than it really was.

TABLE III.

Summary of practical treatments with diazinon resins.

Vessel	*Treated*	*Last date Inspected*	*Result*
Gleddoch J. & J. Denholm Ltd.	15 12 59	5 12 60	Clear
Graigallian J. & J. Denholm Ltd.	2 1 60	15 7 60	Clear
Esso Cambridge Esso Petroleum Ltd.	20 1 60	27 11 60	Clear
Illorin Palm Palm Line Ltd.	22 1 60	4 11 60	Clear
Ormsary J. & J. Denholm Ltd.	15 3 60	28 11 60	Clear
Esso Manchester Esso Petroleum Ltd.	26 4 60	15 7 60	Clear
Sugar Refiner Silvertown Services Shipping Ltd.	20 7 60	17 9 60	Clear
Sugar Carrier Silvertown Services Shipping Ltd.	27 7 60	11 10 60	Clear

electrical cables and a 90 year old infestation of the Argentine ant, *Iridomyrex humilis*, in a British hospital was cleared by treatment with insecticidal resins.

New developments

One of the disadvantages with original insecticidal resins was the necessity to add an acid catalyst or accelerator just before application. This was necessary to make the sprayed film harden and dry within a reasonable time, since insecticidal resins 'dry' or harden chemically by polymerisation. In practical work this procedure was a nuisance because great care had to be taken to ensure thorough mixing of the catalyst with the resin. In addition, any resin which happened to have been left over from treatment could not be stored. It would tend to gel in the can. Today, new insecticidal resins, have been produced with 'drying' agents already built in the lacquer. These new resins are ready to use and can be applied without the addition of any catalyst or accelerator.

This development of self-curing resins in turn made it possible to produce satisfactory insecticidal resins packed in aerosol "press button" spray containers. These aerosol sprays have proved extremely useful in servicing work for touchup treatments and for the 'do it yourself' user of insecticides in the home.

Resins and insect resistance

Towards the end of 1958 and throughout 1959 an increasing number of ships visiting British ports harboured pockets of *Blatella germanica* infestation which did not yield to treatment with insecticidal resins containing dieldrin. Representative samples of these persistent cockroaches were removed from affected ships and compared with non-resistant cockroaches obtained from the Pest Infestation Laboratories at Slough, to determine whether or not the cockroaches were resistant.

The degree of resistance to dieldrin varied from ship to ship, but on quite a number of ships a high degree of resistance was encountered. Cockroaches taken from the *S.S. Clan MacLaren* for example, were still alive after 40 hours exposure in test jars. With the non-resistant strain all males were dead in 20 hours and all females within 28 hours exposure. It became immediately necessary to provide these ships with a long term residual treatment capable of eliminating dieldrin-resistant cockroaches. Fortunately, this problem had been anticipated some years earlier when insecticidal resins containing the organo-phosphorous compounds, malathion and diazinon, had been successfully formulated and tested. Since both diazinon and malathion are liquids, it was necessary to alter the formulation slightly by increasing the proportion of urea-formaldehyde resin to compensate for the plasticizing effect of the liquid insecticides.

Both malathion and diazinon, when incorporated into a resin, behave in a similar way to solid insecticides, except there is a migration of the liquid insecticide to the surface instead of the formation of crystaline bloom.

The insecticidal efficiency of resin films containing malathion was found to vary with age. At the end of one year there is an apparent loss of insecticidal activity but at the end of four years, malathion resins were found to be somewhat more effective than freshly prepared resins. It has been established therefore, that the effective residual life of liquid insecticides can also be increased very considerably by incorporation into resins. Longevity tests with acid accelerated diazinon resin in the laboratory have been under way for one year and two months. After 6 months and 14 months, there were no significant differences between aged surfaces and recently applied diazinon resins (see table 2).

Insecticidal resins containing malathion and diazinon were first used to treat dieldrin-resistant cockroaches in ships early in 1959. Results with malathion resins were variable. In some instances elimination of cockroach infestation was achieved and has been maintained. In other ships, malathion lacquer gave only partial control. Furthermore, a number of complaints were received concerning the odour of malathion resin and this material is therefore no longer used in ship treatments. Diazinon resins have proved to be completely successful under practical conditions. In every instance it succeeded in eliminating infestations of dieldrin resistant cockroaches and up to the time of writing, i.e. after a period of approximately one year, ships treated with diazinon resins have remained free from infestation. Results of practical treatments with diazinon resins are summarised in table 3. In each case the resin was applied to the accommodation, galleys, pantries, messrooms and the crews' quarters. All of the ships were originally infested with cockroaches which did not respond to treatment with dieldrin, they were also subject to constant re-infestation.

It is probable that one day cockroaches will become resistant to one or more organo-phosphorous compounds and insecticidal resins containing these compounds will no longer effect control. It must be remembered however, that insecticidal resins are fundamentally vehicles capable of improving the performance of any residual insecticide. New insecticides which may be produced to deal with new problems of resistance will undoubtedly also be incorporated into insecticidal resins of the future.

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This article is a revised form of the author's article entitled "Insecticidal Resins" which appeared in the October, 1960, issue of "Pest Control". *Further details of the use of organo phosphorous insecticides have been added.*

SOLVENT TYPE WOOD PRESERVATION

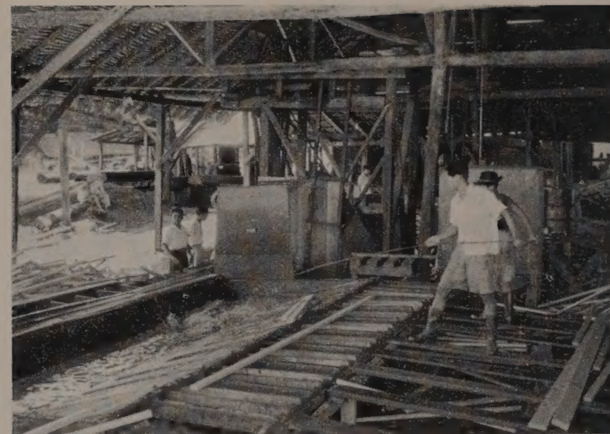
By W. P. K. FINDLAY, B.Sc.

IN RECENT ISSUES of this journal there has appeared a series of articles describing the properties of the toxic chemicals commonly used in solvent type wood preservatives. After reading these articles one is impressed with the range of highly effective chemicals now available to the manufacturers of wood preservatives, but one may be excused for feeling slightly bewildered by the width of choice presented.

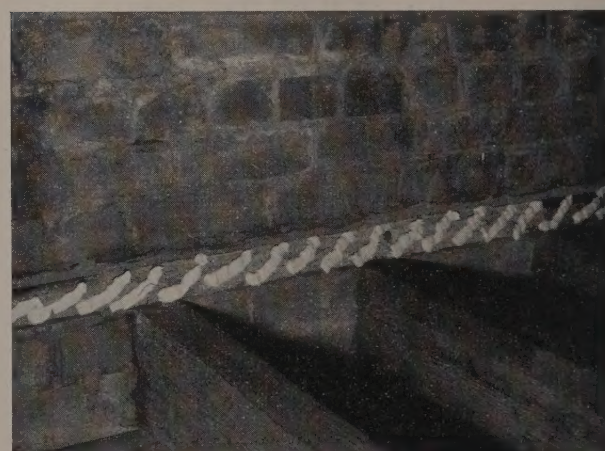
Ample evidence has been published as to the toxicity of these various compounds to insects and fungi, but much less information is available as to their persistence in the wood under service conditions. As many of them have only been developed during the last decade results of really long term service trials cannot yet be available.

When choosing a preservative it is important to decide whether one is aiming to kill insects already present in the wood, or to protect the wood against possible infestation at a later—perhaps much later—date. Many proprietary preservatives are formulated with a mixture of chemicals so as to have both an immediate insecticidal action and also to confer some degree of long lasting protection. There is no doubt that the nature of the solvent and the presence of anti-blooming or water proofing agents can greatly influence the persistence and long term effectiveness of a pest control chemical—a fact which was emphasised by Mr. Sproule in the last sentence of his article on pentachlorophenol.

In presenting the data about pest control chemicals great emphasis is always laid on the toxic limits to the pests. It is generally assumed that the more toxic the chemical the better it is, because theoretically the higher the toxicity the lower the concentration that needs to be used. However it must also be remembered that the lower the concentration the greater may be the risk of the preservative becoming inactivated by some contaminating material.



Ramin being dipped off the saw in Santobrite, Borax and Lyxaston, to protect it from Blue Stain and Powder-post attack during seasoning and shipping. Photo: Preservation Developments Ltd.



Woodtreat containing pentachlorophenol and dieldrin applied to a wall-plate for eradication of Common Furniture Beetle. Photo: Preservation Developments Ltd.

Unlike crop protection, where not only must injury to the growing plants be avoided at all costs, but economy of chemicals must be of paramount importance because of the number of applications made during a season, wood preservatives are applied but once, so there is not the same need to cut the concentrations of active ingredients down to a minimum. Rather should the wood preserver aim to leave in the wood a reserve of toxic materials that will maintain a fully protective layer on the surface.

The toxic hazards associated with many of the pest control chemicals have been underlined by several of the contributors to this series, and the need for protecting operatives using the highly chlorinated insecticides

Rentokil being used for the treatment of roof-rafters against Anobium punctatum. *Photo: Rentokil Group Ltd.*

Rentokil Dry Rot Fluid being used for the irrigation of masonry infested with dry rot. Photo: Rentokil Group Ltd.

has been emphasised. Of those products described probably the ones requiring the greatest care when handling are Dieldrin and the polychloronaphthelenes. Regarding the latter Dr. Hickin commented that "their toxic hazards must be watched closely both in the manufacture and in the package labelling."

Of the products described only pentachlorophenol and the metallic naphthenates are considered as fungicides. These two are somewhat complementary in their behaviour. PCP is highly toxic but it is to a certain degree volatile, especially if it is applied in a light solvent; whereas copper and zinc naphthenate, though not intrinsically highly toxic, are very stable. Cominations of the two, therefore, are often used to good advantage. Fungicides based on copper are particularly effective against the cellulose destroying micro-fungi that cause decay in textiles and soft rot in wood, and copper naphthenate has long been used with success for the preservation of textiles and horticultural timber. Preservatives based on copper naphthenate have the advantage that wood treated with them has no injurious effects on higher plants.

Copper pentachlorophenate, though not strictly a solvent soluble preservative, is a chemical that combines extremely high toxicity with great resistance to leaching and evaporation. It therefore has many potential uses if it can be formulated in such a way that adequate penetration into the wood can be achieved.

Benzene hexachlororide has been found outstandingly effective for the treatment of freshly felled logs against the attacks of ambrosia Beetles (pinhole borers), and is the material of choice for this purpose. It has also been used with success for protecting stacks of susceptible sawn timbers against Lyctus and for this purpose is effective when used at a concentration of 0.5%. It is often applied in combination with sodium pentachlorophenate where protection against staining fungi is also called for. Sodium pentachlorophenate has held its place for many years as the most effective chemical for the prevention of sap-stain on sawn timbers. It is an excellent general fungicide and has found many other applications outside the wood preserving industry.

Monochloronaphthelene is the basis of a well known German preservative which appears to be equally effective against both fungi and insects. There seems to be little information about the fungicidal properties of the more highly chlorinated naphthelenes, but they are certainly likely to have some value as preservatives against fungal decay, though it is mainly as long lasting insecticides that they are included in preservatives for in-situ treatment.

Dieldrin is one of the most potent of the modern insecticides used against wood pests. It has been found to be particularly effective for the eradication of termites from building sites. It has been used very effectively

for the protection of plywood as its toxicity to insects is so high that a small proportion (0.3%) incorporated in the glue will adequately protect all the veneers against any attack.

In the articles reviewed there is little information about the choice of the most suitable solvents. These may themselves have considerable insecticidal power, though they contribute little to the more permanent protection of the wood.

So many different interacting factors contribute to the efficacy of a solvent type preservative that it is not easy to achieve the ideal combination. The manufacture of these preservatives is obviously becoming a more and more skilled operation calling for the co-operation of the biologist, the chemist and the pest eradicator. Among future objectives should be the development of highly effective pest control products that have little or no toxicity to man and animals.

No Mean Adversary (*Cont. from page 181*)

(it has already been employed with success by forestry workers in Paris) further details of the life history and biology of *Oemida* can be discovered.

One particularly pressing problem which it is hoped will be solved is the determination of the range of heat and humidity conditions favourable for the survival of *Oemida*. More detailed knowledge of the insects requirements in this respect will indicate whether or not it will be safe to export East African cypress to countries with a similar climate. So far it appears that *Oemida* cannot survive for long in the conditions of humidity and temperature at Mombasa, the port through which all timber exported from Kenya must pass. Therefore storing the timber for an appropriate time at Mombasa will prevent the introduction of this serious pest to other countries. It is also unlikely that these long horned beetles could survive a long sea voyage. Although overseas foresters will be thankful for this the problem of *Oemida* and other long horn beetles with the same habits but as yet un-named, remains a severe problem with Kenya cypress growers. Twenty years ago *Oemida* attacked the woodwork of a Nairobi hotel to such an extent that it had to be rebuilt. Similar cases were reported in East Africa for the most part only when part of the building collapsed or when someone or an article of furniture disappeared through the floor. Collapse of timbers in this manner was usually the first sign of infestation for the borers insidiously chew away the centre of the timber without revealing any sign of their presence on the surface. It is probably for this reason that it was not realised for some time that *Oemida* could be a pest of standing trees as well as structural timber. Then in 1949, when a cypress plantation in the Kinankop mountains was being thinned, it was found that many of the felled trees were full of holes. Later reports revealed that in some plantations up to 80% of the trees were infested and the borings are usually so extensive that an infested tree is useless Another commercial Kenya softwood, podo, is also favoured by *Oemida*.

Because of their cryptic habit measures against these borers must be preventative. The adult female lays its eggs on the exposed deadwood of pruning scars, broken branches or damaged areas of the trunk. When the eggs hatch the larvae immediately begin to bore their way through the dead wood to the centre of the tree where for approximately 2 years continues its activities, often throughout the whole length of the trunk until maturity. Whilst it is apparent that the beetle could be prevented from laying its eggs or the hatching larvae killed by treating all exposed dead wood surfaces with a repellent, sealing compound or insecticide, this is only feasible in the case of pruning scars which can be treated at the time of pruning.

In the case of damage resulting from natural causes such as branches broken by high winds and trunks debarked by the activities of elephants and buffalo, regular detailed inspection of the trees would be required in order that treatment of exposed surfaces can be carried out before the adult has time to lay its eggs or the larvae has had time to burrow out of range of any insecticide applied to the surface. Much work has been done to try to prevent the original damage which provides *Oemida* with its chance to enter the tree; electric fences, and moats have been built around plantations in an attempt to keep out the animals such as elephants which cause the damage. Specially roughened concrete posts have been erected to provide the animals with "back scratchers" in the hope that they will prefer using them to rubbing the bark off the cypress trees.

Forest hygeine, such as removing old dead tree stumps dead trees, broken branches etc. will help to keep the beetle population down, but all these techniques have so far been of limited success. Indeed control of these borers is so difficult that in the long run it may prove cheaper to grow pine trees instead of cypress as certain species of pine, notably *Pinus radiata* and *P. patula* appear to be unfavourable hosts to these beetles. The probable reason for this is the production by pine trees, of oleo resins, which ooze out through damaged parts of the tree making the surfaces unsuitable for egg laying. It will be recalled here that most of our knowledge of prehistoric insects comes from their preservation in amber, which is fossilized resin.

NEWS AND NOTES

Disposal of Alkali Arsenites

It was agreed in December, 1959 by the National Organisations concerned, that potato-haulm destroyers and weed killers containing sodium and potassium arsenites should not be manufactured for sale in the United Kingdom, and that after stocks had been used up on the 1960 potato harvest, their sale and use should cease completely.

Some farmers, agricultural contractors and merchants may still have some of these materials which they will wish to dispose of as quickly and safely as possible. The Divisional Offices of the Ministry of Agriculture can give advice on their safe disposal and anyone who has any arsenites left should get in touch with his local office.

N.A.A.S. Staff Changes

The National Agricultural Advisory Service gained a new Director on 1st March, 1961, when Mr. W. E. Jones, B.Sc. (Agric.), took over on the retirement from public service of Mr. J. A. McMillan, C.B.E., B.Sc. (Agric.). Mr. Jones, aged 45, who took his degree at the University College of Wales, Aberystwyth, joined the N.A.A.S. when it was established on 1st October, 1946. Originally appointed as a Grassland Officer, he became the County Advisory Officer for Gloucestershire in 1950, was appointed Deputy Regional Director for Wales in 1954 and Regional Director in 1957. Two years later he became Senior Advisory Officer (Agriculture) at headquarters.

Mr. J. Butt-Evans, Ex-County Advisory Officer for Durham, became County Advisory Officer for Yorkshire (North Riding) on 1st April, in succession to Mr. W. S. Rayfield who was recently transfered to Headquarters on promotion. Mr. W. H. Helme, at present Deputy County Advisory Officer for Berkshire, has been selected on promotion to fill the post of County Advisory Officer for Durham on 1st June, 1961, in succession to Mr. J. Butt-Evans.

Mr. G. P. Chater, Ex-Hops Adviser in the West Midland Region, became Director of Rosemaund Experimental Husbandry Farm, Preston Wynne, Hereford, on 1st April in succession to Mr. E. L. Jones, M.Sc., N.D.A. (Hons.).

Mr. Jones succeeds Mr. W. R. Smith, B.Sc., N.D.A., as one of the two Livestock Husbandry Officers for Wales. As already announced, Mr. Smith succeeded Mr. T. C. Creyke as Deputy Regional Director in the Yorks. and Lancs. Region on 25th January.

M.A.F.F. Warning to Farmers

Seed dressings are of great value to agriculture, but they can also bring serious risks to wild life. Seed dressings containing dieldrin, aldrin or heptachlor can kill birds that eat the dressed seed, and may prove fatal to animals that eat the bodies of such birds. Farmers using seed treated with these dressings should take the greatest care, both in storing and when sowing the seed, to ensure that none of it is left where birds or animals, whether wild or domestic, can get at it.

The higher dosages of these three insecticides designed to guard against wheat bulb-fly are particularly dangerous to wild life. This strength of dressing should be used only where there is a real need for it, and not as a routine measure of protection. In practice this means that it should be used only on winter wheat, and then only in areas where there is a real danger of attack from wheat bulb-fly.

It is dangerous to feed any creatures with food containing seed dressed with insecticides and such seed should not therefore be mixed with untreated seed. The spreading of poisoned grain as a bait is an offence under the protection of Birds Act.

If there is any doubt about the need to use dressed seed in particular circumstances, farmers should seek the views of their district advisory officer.

International Aerosol Congress and Exhibition

The third International Congress organised by the Federation of European Aerosol Associations (F.E.A.) under the auspices of The International Aerosol Association (I.A.A.) will be held from 4th to 6th October, 1961, in the Congress House, Lucerne, Switzerland.

The first International Aerosol Exhibition will be held during the period of the Congress but will cover two extra days, running from 4th to 8th October, 1961, The Exhibition will be housed in the Kurst-und Kongresshaus, Lucerne.

Preparatory work for the Congress has been completed. It is planned to include a series of lectures by prominent experts. Papers will be presented covering scientific, technical and commercial aspects of the aerosol field. Time for discussion will be provided.

A new innovation this year will be an Aerosol Packing Contest, organised by F.E.A.

Travelling facilities, (including cheaper rates for single travellers as well as group arrangements) and hotel accomodation for Delegates will be covered by the International Travel Office of Thomas Cook and Son Ltd., Lucerne, which boasts 90 Hotels is situated on the Lake of Lucerne, and provides an excellent venue for the Congress.

Further information on the Congress, including Programme and application forms, will be available from the I.A.A., Waisenhausstrasse 2, Zurich 1, Switzerland.

Prompted by the rapid development in recent years of the Aerosol Industry in Europe, this Exhibition will be the first of its kind in the world.

The Exhibition is open to firms from all over the world connected with aerosol production (i.e. manufacturers of metal boxes, glass containers, valves, loading equipment, propellents, etc., as well as manufacturers of finished products, contract loaders etc.) Firms in this field wishing to take part in the Exhibition are invited to contact the President of the Exhibition Committee, Mr. Arthur Wettler, c/o Pluss-Staufer A. G., Oftringen, Switzerland. Application forms will then be made available. The Exhibition will be open to the public, and admission will be free.

A catalogue will be published by the Exhibition Committee and orders for advertisements should be addressed to Mr. Wettler.

A large attendance is anticipated and the Exhibition should stimulate interest and demand for aerosol products.

Travel and accommodation will be covered by Thomas Cook & Son Ltd., and will include similar advantages as for Congress delegates.

Increase in Cotton Yield

In a press release from Tanganyika it is stated that many more farmers benefitted from the cultivation of cotton in the Pare District in 1960 than in 1959. By the middle of February 1961, although the final figures were not yet available, it was estimated that the annual cotton crop for 1960 in the whole district would exceed 1,000 tons. It is anticipated that many more farmers in the Pare District would be willing to cultivate cotton this year for their own benefit.

Insecticide experiments which were carried out in the Pare District in 1960 gave the following results: At Kisangiro in North Pare, the mean yield of seed cotton in pounds per acre were very high: eg. Sprayed 2,973 lbs. Dusted 2,143 lbs. and control 1,256 lbs.

At Makanya in South Pare, the results were: Sprayed 840 lbs.; Dusted 484 lbs. and control 391 lbs.

These figures emphasize the importance of using insecticide if a decent yield is to be obtained and further, they demonstrate the superiority of spraying over dusting.

It is hoped that the results of these experiments will inspire cotton farmers to use insecticide in their cotton plantations whenever possible and give preference to spraying over dusting. (*We have not yet been able to discover the insecticide used.—Ed.*)

Export of Insecticidal Paint

Nearly 1,000 gallons of Lakil Insecticidal Paint, a product of J. Manger and Son, of Kingsland, London, E. 8., have been ordered by overseas countries so far this year.

An order for 500 gallons is for distribution by Chop Teck Seng, Importers and Exporters, of Singapore. A batch of 200 gallons for Levant Ali Houses Ltd., of Beirut, will be distributed from Damascus, and a further 250 gallons for the Savoy Hotel, Rome, will be used for interior decoration purposes.

Lakil is a gloss enamel paint which contains the two powerful residual insecticides aldrin and dieldrin.

Supplied in a range of eight colours, plus black, white and clear, it can be applied in exactly the same manner as ordinary paint. Two of its greatest advantages are its freedom from offensive odours and the ability to retain its lethal properties for the whole life of the paint. Washing down increases its potentialities.

Mr. H. W. Taylor, Manger's Export Manager, states that the orders represent the first step in a drive to increase export sales.

"We feel sure that once the advantages of Lakil become more widely known, the overseas market will continue to expand steadily in spite of import restrictions and local competition", he predicts.

Recently the *Good Houskeeping Institute* awarded their Seal of Guarantee to Lakil Insecticidal Paint and Undercoat. Lakil was stated to be satisfactory in all cases and to justify the manufacturers' claims.

New Broad-leaved Selective Weedkiller from Dow

Mecopon is the name of a new broad-leaved selective weedkiller to be marketed by Dow Agrochemicals Ltd., London and King's Lynn.

This is a formulation based on mecoprop (CMPP) and fenoprop (silvex), Mecopon, which has Ministry approval and will not sterilise the soil, is non-poisonous, and is applied by low volume sprayer. There is no necessity for wearing protective clothing during application. As it controls such arable pests as charlock, fat hen, orache, cornbuttercup, docks, poppy, wild radish, annual nettle and creeping thistle, it is of considerable value as a safe alternative to the highly poisonous chemicals which were formerly used for the control of these weeds. Notably it controls cleavers and chickweed which have formerly resisted such chemicals as those of the MCPA group.

The new weedkiller is being introduced by a competition based on the identification of weeds from silhouettes, the first prize being a Massey-Ferguson "35" de luxe Diesel tractor. Entrants are invited to participate in the production of a "weed map" of Britain by listing the six most troublesome weeds on their respective farms.

Big Russian Contracts for Fisons and CJB.

Two contracts worth more than £2 million have been awarded to a company formed by Fisons and Constructors John Brown Limited (CJB) for the design, supply and commissioning of two major chemical plants for the USSR by Techmashimport of Moscow.

The contract negotiations were handled by the new company, Wycon Services Limited, specially formed for the purpose of exporting chemical plants based on Fisons and CJB technical know-how. The work will be executed by Constructors John Brown Limited, Whiffen and Sons Limited (the industrial chemical subsidiary of Fisons), and Fisons Pest Control Limited. The contracts have been awarded on a cash payment basis.

One plant is for the production of dimethylol ethyleneurea (DMEU) which is used in the manufacture of "drip-dry" fabric. The plant includes a high degree of automation and can produce 12,000 tons per annum. The design of this plant is based on the know-how of Whiffen and Sons Limited and this contract is worth over three-quarters of a million pounds.

The other contract is for a plant to produce 4,200 tons per annum of the weedkiller MCPA. The total value of the contract for the MCPA plant is £1,353,000. The plant is modelled on the existing Fisons MCPA plant at Harston but has much greater capacity.

In addition there will be more automation in the Russian plant, which to meet Russian requirements, is designed to produce solid MCPA as opposed to the liquid form produced in Britain. Output of the plant is 4,200 tons of 100% technical material. This is equivalent to 3,760,000 gallons of liquid MCPA as produced by Fisons, and is sufficient to treat 11 million acres of cereals.

These contracts stem from an exchange of technical missions of Soviet and Fisons' scientists extending over the past two years, during which the plants mentioned above and other projects, have been discussed.

Fisons will be exhibiting at the British Trade Fair, Moscow, to be held in May this year. Constructors John Brown Limited, secured, last autumn, two other major contracts worth nearly £3 million for chemical plants in the U.S.S.R.

New Haulm Dessicator

Following the decision taken last year by manufacturers of agricultural chemicals to cease manufacture of sodium/potassium arsenite potato haulm killers, Shell Chemical Co. Ltd. announce the introduction of a

new potato haulm destroyer — Holtox. It is stated that the new product is harmless to man, stock and game; it is non-corrosive, non-tainting and has such short persistence in the soil that the ground could even be recropped only 14 days after spraying.

Holtox will cost the farmer 45/- per acre, the rate of application being 2½ gallons in 20-40 gallons of water to the acre. The new product, available in 5 gallon cans and costing 18/- per gallon, will be sold by Shell Appointed Distributors, it can be applied in any low volume spraying equipment and protective clothing is not necessary because the product is non-toxic. Leaf kill can be expected within 3-4 days and there is complete dessication of the haulm in 12-14 days.

The active constituent of the product has not yet been disclosed.

Seventh International Packaging Exhibition

In 1953 it was estimated that British industry spent over £300 millions a year on packaging; by the end of 1960 this estimate had risen to some £600 millions. But the growth and development of packaging techniques throughout the world is perhaps most clearly reflected in the rapid expansion in both size and importance of the International Packaging Exhibition which this year will be held at Olympia, London from September 5-15, 1961.

This year's exhibition will certainly be the largest post-war packaging exhibition and there is still nowhere in the world where such a large, comprehensive and truly progressive display of packaging materials and equipment can be seen.

The International Packaging Exhibition provides a shop-window, not only for British packaging manufacturers hoping to interest British and foreign buyers, but also for Overseas manufacturers, who know that buyers from all countries will attend the London "I.P.E."

The whole field of packaging - machinery, materials and containers- as well as bottling and package handling will be covered. New equipment on show this year will include machines for the high-speed automatic filling, sealing and capping of containers; packing, parcelling and wrapping machines; case erection equipment; case gluing and taping machines; bag-making equipment, and bottle cleaning, sterilising and filling equipment.

The latest types of metal, glass, plastic, fibre and aerosol containers will be on display together with many new types of closure and new drip-proof pouring devices. The latest developments in sealing tapes, adhesive coating and inks for package printing will be exhibited. There will also be a great variety of packaging materials including new reinforced papers and the latest transparent films with high resistance to moisture, temperature variations, acids, etc.

Among the ancillary equipment covered by the exhibition there will be tape-sealing machines, tape dispensers, automatic machinery for applying tensional steel strapping or wire, new high speed labelling machines, converting machinery, printing machines, check-weighing equipment and electronic devices for detecting the presence of foreign bodies in foodstuffs.

The Seventh International Packaging Exhibition will present manufacturers of any commodity, with an unrivalled opportunity to aquire the complete information necessary for any type of product packaging. The manufacturer will also have the chance to compare one type of package or packaging process with a variety of others before making a final choice. Buyers will be able to talk to their suppliers' technical experts about the special problems presented by individual products or the conditions to which they are submitted.

This great international packaging show should be a "must" in the diary of every manufacturer who wants to reduce labour costs and increase output by taking advantage of the latest efficient and competitive packaging techniques.

Laboratory Apparatus and Materials Exhibition

Many new products will be exhibited for the first time in this country at this year's Laboratory Apparatus and Materials Exhibition at the Royal Horticultural Society's New Hall, London, June 19-22.

A special feature of this exhibition is a series of twelve scientific lectures on recent advances in laboratory techniques—three each day—in the lecture hall. The subjects include:

"Radio-Frequency Methods in Analytical Chemistry" "Vapour Phase Chromatography" "The Biological Assay of Insecticides"

British and overseas apparatus, equipment and materials will be shown during the four days of this exhibition. Scientists and laboratory executives in all branches of industry, research, medicine, education and national and municipal government will be able to see demonstrations of apparatus and the latest developments in laboratory equipment.

Cooke, Troughton & Simms Limited (Haxby Road, York) will exhibit a selection of their microscopes, a 35mm. Colour Snap camera particularly suitable for use with their M12 and M15 series microscopes also, as agents for Struers of Copenhagen, two polishing machines—the Disa Electropal and the DP IV Polisher.

Endecotts (Filters) Limited (Lombard Road, London SW 19) will show their Test Sieves to B.S. and U.S. Standards, also stainless steel Test Sieves, Pocket 'Interchanger' Sieves and ancillaries. The rapid separation of particles will be demonstrated with transparent rimmed test sieves on an Endrock test sieve shaker.

Oertling Limited (Cray Valley Works, Orpington, Kent) will exhibit and demonstrate a range of their precision balances. One of the most interesting shown on this stand will be the QO1 Decimicro balance which has high sensitivity and comparatively large total weight capacity.

The Permutit Company Limited (Permutit House, Gunnersbury Ave., London W.4) are demonstrating their complete range of portable Deminrolit units operated on the ion exchange principle. Purified water to B.P. Specifications is produced at flow rates of up to 12 gallons hourly. A display of the large variety of ion exchange materials produced by Permutit, including Zeo-Karb and De-Acidite ion exchangers, will be shown together with demonstration columns illustrating the versatility of these materials in analytical work.

Stanton Instruments Limited (119 Oxford Street, London W.1) are exhibiting and demonstrating a range of their Unimatic single pan constant load balances with sensitivity varying from 1mg. to 0.01mg., by vernier, widely used in scientific teaching and educational establishments. The Stanton Thermobalance will also be on show. This has been further developed and is now capable of reaching the hitherto unobtainable temperature of 1550C°.

Sun Screens for Pyrethrum

Pyrethrum is attractive as an insecticide because it leaves no toxic residues on plant tissues. It does, however, have the disadvantage that, in sunlight, rapid photolysis or decomposition occurs, accompanied by loss of biological activity when exposed to the sun. Suggestions that its effectiveness could be prolonged by the addition of para-amino-azobenzene (PAAB—U.S. Patent No 2,772,198) or by the introduction of a light-absorbing dyestuff which would act as a screen, have recently been investigated in detail at the Research Laboratories of the Pyrethrum Board of Kenya at Nakuru.

Removal of the dark green colouring matter present in crude preparations of pyrethrum markedly increased its stability in sunlight, and further improvement was achieved by the addition of PAAB and, to a lesser extent, by a number of anti-oxidants such as resorcinol, pyrogallol, catechol or hydroquinone. The data suggest that these compounds act primarily as protectants for pyrethrin II and cinerin II, whereas the absence of "chlorophyl" pigments enhances the stability of pyrethrin I and cinerin I. PAAB appears to inhibit the formation of the molecular fragments known as free radicals which are necessary intermediates for photochemical decomposition.

Protection by light absorption is considered to be less promising, for the experiments have demonstrated that a wide range of wavelengths is involved in the inactivation of pyrethrins. In fact, none of the fifteen dyestuffs and ultraviolet light absorbers tested were as effective as PAAB in retarding the rate of photolysis. Since PAAB is known to be carcinogenic, further progress would appear to depend on finding an equally potent chemical stabiliser with low mammalian toxicity. Work on these lines is proceeding. Meanwhile the refined pyrethrum extracts now available should facilitate the manufacture of formulations of pyrethrum insecticides more stable in sunlight than the earlier crude ones.

Baffling Grain-Eating Birds

In its experiments at Serere, in Uganda, on production of sorghum grain which will be resistant to attacks by birds (one of the principal reasons why it is not widely grown in East Africa) the East African Agriculture and Forestry Research Organization is trying to introduce a bitter seed coat to the grain.

E.A.A.F.R.O.'s Director reported this to the Agricultural and Fisheries Research Council recently, and said the bitter seed coat could be easily removed by farmers.

New Products for Fruit Growers

May & Baker Ltd. have added five new products to their range of top fruit sprays. The introductions are DDT concentrate, BHC/DDT concentrate, and three entirely new products 'Crotothane' brand 25% dispersible dinocap, 'Embathion' brand 50% ethion, and 'Trosan' brand phenyl mercuric nitrate.

'Crotothane' is a non-poisonous fungicide which will control medium to severe infections of powdery mildew on apples, and American gooseberry mildew. It is particularly recommended for sulphur-shy varieties of top fruit. 'Crotothane' is both an eradicant and a protectant. Continued use throughout the growing season will also help to keep fruit tree red spider mite in check. It should be used at 12-14 day intervals at the rate of 1 lb./100 gall. high volume or 2-2½ lb./acre low volume, from pink bud to the end of June, or till mid-July in the case of severe infections. Even more efficient, particularly during hot weather is the 7-day programme using ½ lb./100 gall. high volume, and 1¼ lb./acre low volume.

May & Baker state that during the past season research and commercial trials have shown that a combined 'Azosan'/'Crotothane' programme is outstandingly good, particularly for high-class dessert fruit. 'Azosan' is used for the control of apple scab, and has some effect on mildew. The addition of 'Crotothane' completes the control of mildew and the mixture can be used in a 12-14 or 7 day programme.

'Embathion' is a 50% self-emulsifying solution of ethion, an organophosphorus contact acaricide and ovicide for use on apples. It is stated to be the first material to be introduced into Britain which will control all stages of fruit tree red spider mite, including both summer and winter eggs. Used at the recommended rates, ethion is relatively harmless to predators. It is persistent and usually only one application is necessary, at the rate of 16 fl. oz./100 gall. high volume or 40 fl. oz. in not less than 20 gall. low volume. It can be applied at any time up to a month before harvest, but in practice the most convenient time usually coincides with the first DDT codling spray in early June. Putting on up to three post-blossom DDT sprays may cause a red spider build up, but this can be controlled in all its stages with a second 'Embathion' spray.

'Trosan' another new product introduced this season, is the M & B brand of the fungicide phenyl mercuric nitrate. It is a wettable powder containing 1.5% organically combined mercury for use on culinary varieties of apples. It is a scab eradicant and should be used at the rate of 2 lb./100 gall. high volume or 5 lb./acre in not less than 50 gall. low volume, immediately following a Mills period or at intervals of not more than ten days from bud burst to mid-July.

Pyrethrum Appointment

Edinburgh University graduate Mr Richard Grant Allan has been appointed Chief Entomologist to the Pyrethrum Board of Kenya which controls the production of Kenya pyrethrum.

Mr. D. Glynne Jones, whom he succeeds as Chief Entomologist, is now concerned with the co-ordination of the activities of the Pyrethrum Technical Information Centre, the Board's technical information service.

The Pyrethrum Board of Kenya has also recently appointed a native of Fort William, Mr. Donald Maciver, to work as a research chemist at its laboratories in Nakuru, Kenya.

Correction

Mr. D. S. Papworth and Mr. Cann, whose letter was published in "Pest Technology", March 1961, p. 151, are officers of the Ministry of Agriculture, Fisheries and Food, Infestation Control Laboratory, Hook Rise, Tolworth, Surbiton, Surrey, and **not** of the Agricultural Research Council's Pest Infestation Laboratory, Slough.

APPOINTMENTS VACANT

THE MURPHY CHEMICAL Co. Ltd., Wheathampstead, St. Albans, Herts., require graduate in Agriculture or Natural Science, for Export Technical Dept., with good personality and experience in pesticide field. Work entails considerable travel; knowledge of languages essential. Apply, giving full particulars, to Personnel Officer.